



Evidence for metasomatism of lower crustal xenoliths from beneath Scotland.

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Alkaline mafic magmas containing mantle and lower crustal xenoliths and megacrysts intruded during late-Palaeozoic intraplate magmatism across Scotland. Spinel lherzolite mantle xenoliths occur together with pyroxenitic (*s.l.*) ultramafic cumulates and metagabbroic/dioritic cumulates. Anorthoclase-rich xenoliths (anorthoclases) and megacryst assemblages were associated with the ultramafic cumulates. The latter, (wehrlites, clinopyroxenites etc.), considered to compose the deepest part of the lower crust, have commonly undergone modal metasomatism, involving introduction of pargasite and biotite. The metasomatism is attributed to repetitive infiltration by Si-deficient melts rich in Fe, Ti, K, LREE, C and S. The metasomatic agents are inferred to have been small-fraction asthenospheric melts for which the ultramafic cumulates acted as a reactive trap.

Generally seen only as discrete megacrysts, the anorthoclase suite is also represented by xenoliths in which the alkalic feldspar (principally anorthoclase) is accompanied by Fe-rich pyroxenes and biotites together with magnetite, apatite and zircon. The suite was quasi-contemporaneous with the host magmatism and is deduced to originate from veins within the ultramafic cumulates. The anorthoclases were prone to partial melting and disintegration during magma ascent. Those most enriched in incompatible elements contain Nb oxides and are also peraluminous, with modal corundum. Evidence suggests that crystallisation occurred in dynamic magmatic environments. Mineral compositions reflect fluctuations in Th and U of their parental melts that, in extreme cases, had REE concentrations of up to 4000 x-chondritic. Highly potassic veins and patches common in the anorthoclases, are attributed to Na leaching by pervading melts/fluids. Still younger (but also pre-entrainment) calcite micro-veins are

rimmed by K-feldspar enriched in Li, B, Mg, Ca, Ti, Sr, Nb and Fe.

The addition of LREE, Nb and the association with calcite suggest that carbonatitic small-fraction melts played a major role in the metasomatism of the ultramafic cumulates as well as in the genesis of the anorthoclase suite.